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José Manuel Rivero-Carvalho and the Tricuspid Valve

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Introduction

During the first half of the 20th century, Mexican cardiology experienced exponential growth, made possible by the creation of advanced medical centers, the development of specialized educational programs, and cooperation with foreign institutions. This progress, however, could not have been possible without the leading role taken by remarkable physicians, many of whom had studied abroad and brought their newly acquired knowledge back to their motherland. One of those physicians was José Manuel Rivero-Carvalho (Figure), a clinical cardiologist who dedicated most of his life to the study of the tricuspid valve and described the maneuver and sign that, up to this day, carry his name.

José Manuel Rivero-Carvalho was born in the town of Tehuacán, in the Mexican state of Puebla, on April 1, 1905.¹ He attended medical school in the city of Puebla and, in 1928, received a scholarship from the French government and traveled to Paris, where he finished his studies as a colonial medical officer. In 1932 he obtained the degree of doctor at the University of the Sorbonne, with the thesis titled “La pression artérielle au tours de l’anesthésie et de certaines interventions chirurgicales” or “Blood pressure changes during anesthesia and certain surgical interventions.”¹ He then became a member of the cardiology clinic of the Hôpital de la Pitié in Paris; there he was one of the disciples of French cardiologist Louis Henri Vaquez who, alongside William Osler, first described the clinical signs of polycythemia.²

In 1934 Rivero-Carvalho returned to Mexico and, after revalidating his physician degree in the National Autonomous University of Mexico, won a position in the cardiology ward of Mexico’s General Hospital.¹ That ward, number 21, was directed by famous Mexican cardiologist Ignacio Chávez, who would later establish the first cardiology residency, the first cardiology journal, and the first cardiology hospital in the country.³

When, in 1944, Chávez moved the cardiology ward to the newly created National Institute of Cardiology (INC), Rivero-Carvalho was among the physicians who followed him. The INC would go on to become the blueprint for the creation of many of Mexico’s most important health institutions, and to this day it remains one of Latin America’s leading cardiology centers. Rivero-Carvalho directed

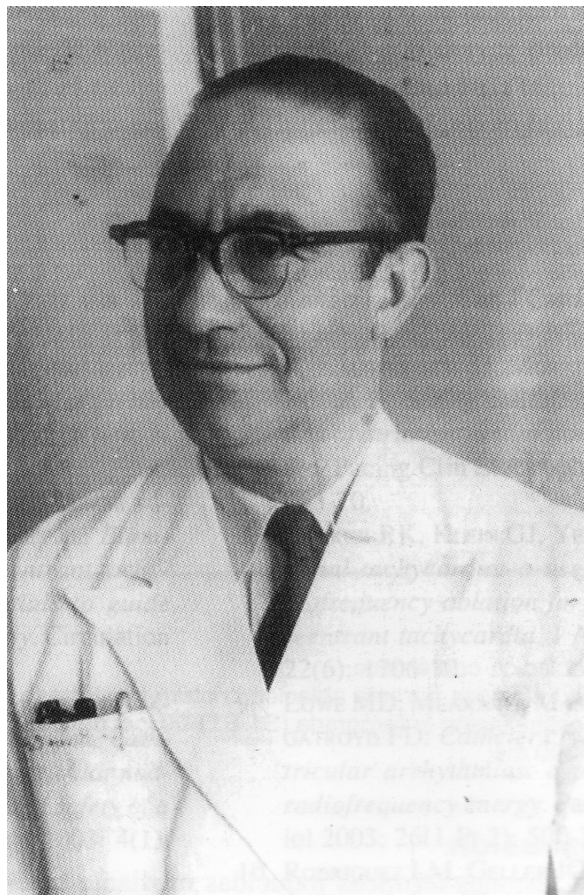


Figure. José Manuel Rivero-Carvalho. From the author’s personal collection.

the women’s pavilion, on the second floor of the institute, and stood up as an extraordinary clinician who was well appreciated by his pupils.⁴

The Rivero-Carvalho Sign in Tricuspid Insufficiency

In 1946, while Rivero-Carvalho worked at the INC, he published a paper titled “Signo para el diagnóstico de las insuficiencias tricuspideas” or “A sign for the diagnosis of tricuspid insufficiency.” The article was published in Spanish in the journal *Archivos del Instituto de Cardiología de México*.⁵ Rivero-Carvalho studied 4 groups of patients. The

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first group had clinically evident tricuspid insufficiency. The second group had clinically evident mitral injuries, without any tricuspid pathology or arrhythmias. The third group was made up of patients with tricuspid rheumatic heart disease and arrhythmias. Finally, the fourth group included patients with heart failure or arrhythmia without rheumatic heart disease.⁵

Rivero-Carvalho applied his newly described maneuver to these 4 groups of patients. The maneuver consisted of requesting the patient to make deep inspirations and hold an inspiratory apnea.⁵ This was better done with the patient in a seated position.⁶ The sign produced by the maneuver consisted of an increase in the intensity of the tricuspid murmur. The intensification of the murmur was described as absolute in the majority of cases, with a maximum intensity over the tricuspid region and with an irradiation toward the mesocardium or the hepatic zone.⁵ He also noticed that not only were the murmurs reinforced, but their tonality and tone also changed, turning them rough, like a steam jet.⁶ Rivero-Carvalho found that the sign's positivity was independent of heart rhythm or frequency, and that it could even be found in patients with atrial fibrillation.^{5,6}

With the help of Dr. Isaac Costero, head of pathology at the INC, Rivero-Carvalho reviewed the autopsies of 11 patients with proven tricuspid insufficiency. He found that 10 of those patients had a positive sign before their deaths, concluding that the sign was positive in 90% of cases of tricuspid regurgitation.⁵

Rivero-Carvalho's explanation of the increase in the intensity and tonality of the tricuspid insufficiency murmur as a consequence of deep inspiration was the fact that such circumstance increased the blood flow in the veins that fed the right heart. This increase in blood flow, in turn, produced an increase in the pressure, the velocity, and the volume of blood passing through an insufficient tricuspid valve, and thus augmented the intensity and height of the murmur.^{5,6}

In the paper, Rivero-Carvalho postulated 2 main concepts. The first was that tricuspid systolic murmurs are increased during a maneuver of inspiratory apnea, and that systolic mitral murmurs diminish its intensity during such a maneuver, which differentiates them clearly.⁵ The second was that postexpiratory apnea increases aortic and mitral murmurs and decreases the intensity of tricuspid murmurs.^{5,7} Rivero-Carvalho emphasized that by using his maneuver, tricuspid injuries could be recognized prematurely, before any systemic repercussion occurred.⁵

Modern studies regarding the usefulness of Rivero-Carvalho's maneuver in the identification of right-sided murmurs have shown a sensitivity ranging from 61% to 100%,^{8,9} and its use is mentioned in hundreds of books on cardiology and propedeutics, making it a very valuable clinical tool.

Other Works on the Tricuspid Valve

Even though Rivero-Carvalho's greatest contribution to cardiology was the description of his maneuver for tricuspid insufficiency, he also published other original

and innovative papers regarding various disorders of the tricuspid valve. In 1950 he described the use of his maneuver in the diagnosis of tricuspid stenosis, noting that during inspiratory apnea, the intensity of the diastolic murmur and the opening snap of the valve were increased.¹⁰ He described the diastolic murmur of the tricuspid valve as "sometimes rough and without tumble, with a variable intensity, going from that of a steam jet to almost imperceptible, and with a length depending on the physiopathology of the right heart."¹⁰ Rivero-Carvalho suggested once again that inspiratory apnea, by increasing the amount of blood delivered to the right heart, amplified the acoustic phenomena originated in the tricuspid valve.

In 1951, Rivero-Carvalho noticed that in some patients with tricuspid stenosis, the maneuver had to be repeated several times before obtaining the sign. He also discovered that in some patients with a positive sign, the murmur disappeared as the disease progressed.¹¹ After thorough research that included 27 autopsies, Rivero-Carvalho and Helena Ramírez-Jaime published a paper giving an explanation for this phenomenon.¹¹ They found out that some patients with tricuspid stenosis developed a massive enlargement of the right atrium with myocardial degeneration and a thinning of the free atrial walls. They called this finding atrium papyraceum (or paper-thin atrium), due to the similarity of the atrial walls to papyrus, and divided it into 2 different categories.¹² In grade I atrium papyraceum, intact myocardium prevailed over papyraceous auricular tissue, and thus a repeated maneuver was needed in order to achieve a full dilation of the atrium and to offer the necessary resistance for the inspiratory reinforcement of the murmur. In grade II atrium papyraceum, the papyraceous auricular surface prevailed over intact myocardium, and thus the atrium offered no resistance whatsoever to blood flow through the tricuspid valve, extinguishing the murmur.^{11,12}

During his studies of patients with tricuspid disorders, Rivero-Carvalho also noticed that, in some patients, tricuspid acoustic phenomena shifted toward the left, occupying the space of the mitral region.¹³ He performed several radiological, electrocardiographical, pathological, and clinical observations and concluded that, due to the growth of the right cavities, the heart of these patients rotated clockwise along its longitudinal axis and counterclockwise along its transverse axis, with the right ventricle occupying the anterolateral aspect of the chest and the left ventricle facing backward.⁷ He described a maneuver that allowed the examiner to differentiate the "true" apex (the left ventricle) from the "apparent" palpable apex (the right ventricle), calling it the "sign of the double apical thrust."¹³ In this maneuver, "The patient is placed on his back and the apex area is located. The palm of the hand is placed over this area while the fingertips are placed from the fourth to the seventh intercostal spaces at the level of the left axillary line. Without separating the hand, the patient is asked to turn to his left, at which time a new apical thrust appears under the tips of the explorer's fingers, identifying the true apex."¹³ Using this maneuver, the examiner would then be able to look for the sign of inspiratory apnea over the tricuspid region.

Conclusion

After dedicating his entire life to the study of cardiology, Rivero-Carvalho died in Mexico City on February 15, 1993.¹ His name will forever be linked to tricuspid insufficiency and to the maneuver he described in 1946, but his contributions to the pathology of the tricuspid valve were many. Rivero-Carvalho's sign (and the maneuver needed to obtain it) is perhaps the only well-known and fully accepted Mexican eponym used in the medical sciences, and thus its importance to Mexican cardiology, and to Mexican medicine as a whole, is paramount. Even in these days of raging technology, when the clinical skills of cardiac auscultation slowly lose their leading role in cardiology, Rivero-Carvalho's contributions still remain to remind us of a time long gone.

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